(19) BUNDESREPUBLIK DEUTSCHLAND

DEUTSCHES PATENTAMT

(12) **Offenlegungsschrift**

(11) **DE 3417746 A1**

(51) Int. Cl. 4: C 09 J 7/02

(21) Aktenzeichen: P 34 17 746.9
(22) Anmeldetag: 12. 5. 84
(43) Offenlegungstag: 14. 11. 85

DE 3417746 A1

(71) Anmelder:
Jackstädt GmbH, 5600 Wuppertal, DE

(74) Vertreter:
Rieder, H., Dr.rer.nat., Pat.-Anw., 5600 Wuppertal

(72) Erfinder:
Erfinder wird später genannt werden

Prüfungsantrag gem. § 44 PatG ist gestellt

(54) Selbstklebeschicht mit auf der ihrem Träger abgewandten Seite angeordneter Abdeckung

DE 3417746 A1

Jackstädt GmbH, Bembergstraße 2, 5600 Wuppertal 1

A N S P R Ü C H E

1. Selbstklebeschicht mit auf der ihrem Träger abgewandten Seite angeordneter Abdeckung, welche eine zwischen Selbstklebeschicht und Abdeckung liegende klebstoffabweisende Schicht aufweist, dadurch gekennzeichnet, daß die dem Träger (2) abgewandte Fläche (5) der Selbstklebeschicht (1) höckerartig oberflächenprofiliert ist.

2. Selbstklebeschicht nach Anspruch 1, dadurch gekennzeichnet, daß die Höcker (H) pyramiden- oder kegelförmig gestaltet sind von etwa ein Viertel bis halber Höhe der Selbstklebeschicht (1).

3. Verfahren zur Herstellung einer Selbstklebeschicht gemäß Anspruch 1, dadurch gekennzeichnet, daß die mit der klebstoffabweisenden Schicht (9) ausgestattete Abdeckung (8) an der Schichtseite in das höckerartige Oberflächenprofil verformt wird, anschließend die Oberflächenprofil-Vertiefungen (11) mit dem entsprechend flüssigen Kleber ausgefüllt und überlagert werden und daran anschließend die Fläche (4) des Trägers (2) auf die obere, freiliegende Klebstoffseite (1') aufgebracht wird.

4. Verfahren nach Anspruch 3, dadurch gekennzeichnet, daß die Abdeckung (8) durch Eindrücken von der beschichteten Seite her oberflächenprofiliert ist.

Selbstklebeschicht mit auf der ihrem Träger abgewandten Seite angeordneter Abdeckung

Die Erfindung bezieht sich auf eine Selbstklebeschicht mit auf der ihrem Träger abgewandten Seite angeordneter Abdeckung, welche eine zwischen Selbstklebeschicht und Abdeckung liegende klebstoffabweisende Schicht aufweist.

Es ist ein selbstkleberbeschichtetes Flächenprodukt bekannt, dessen Kleber zeitverzögert aushärtet, wodurch noch genügend Zeit für die eventuell erforderliche Lagekorrektur verbleibt. Darüber hinaus kennt man repositionierbare Träger für Aufdrucke bzw. sogenannte Poster, deren Selbstklebeschicht zwei Komponenten enthält. Die eine bringt gleichsam eine provisorische Haftverbindung, während die endgültige Klebebefestigung durch Zerstören mikrometrisch kleiner Einzelbehälter, welche die zweite, die endgültige Aushärtung bewirkende Komponente enthält, erfolgt. Solche Behälter platzen durch Ausübung eines stärkeren Andrucks auf den Träger. Beide Lösungen erfordern spezielle Kleber und dementsprechend aufwendige Fertigungsmaßnahmen.

Aufgabe der Erfindung ist es, eine gattungsgemäße Selbstklebeschicht anzugeben, deren Wirksamkeit weder von einem besonderen Zeitfaktor abhängt, noch den Einsatz spezieller Kleberkombinationen erfordert, trotzdem aber, bspw. zur Durchführung von Lagekorrekturen des Trägers, ohne jegliche Beeinträchtigung der End-Haftwirkung ein Ablösen erlaubt.

Gelöst ist diese Aufgabe gemäß der Erfindung dadurch, daß die dem Träger abgewandte Fläche der Selbstklebeschicht höckerartig oberflächenprofiliert ist.

Zufolge solcher Ausgestaltung ist eine gattungsgemäße Selbstklebeschicht von erhöhtem Gebrauchswert geschaffen: Das rauhe Oberflächenprofil der Selbstklebeschicht bringt eine Repositionierbarkeit mit einfachsten Mitteln. Lediglich die freien Enden der Höcker treten bei nur leichtem Andruck mit dem Haftgrund in Verbindung. Der Kleberkontakt umfaßt nur einen geringen Bruchteil der durch stärkeren Andruck aktivierbaren Klebefläche. Durch die Reliefstruktur ist die klebeaktive Oberfläche sogar noch erheblich vergrößert. Dies wirkt sich günstig aus, wenn bspw. Haftetiketten auf rauhen Oberflächen von Textilien, Keramik, Verpackungskartons, Kunststoffkanistern oder dergleichen angebracht werden sollen. Es tritt unter Ausfüllung der Rauhungsvertiefungen ein in die Tiefe gestaffelter, verzahnender Ineinandergriff auf. Darüber hinaus ergibt sich eine wesentliche Reduzierung der Selbstkleberschicht-Auftragsmenge, wodurch eine Senkung der Herstellungskosten erreicht ist. Eine höckerartige Oberflächenprofilierung begünstigt auch die Vorratshaltung in Form eines Wickelkörpers; die Spannungen werden in der Reliefstruktur praktisch kompensiert. Die Oberflächenprofilierung kann in geometrisch gleichmäßiger Struktur sein bzw. für bestimmte Verwendungszwecke vorteilhafterweise auch ungleichmäßiger Verteilung der Höcker gestaltet sein, z. B. wenn das Produkt vordergründig abgestimmt sein soll auf die verbesserte Verklebung zu rauhen, also unregelmäßig strukturierten Oberflächen. Eine besonders günstige Reliefstruktur ergibt sich in der Weise, daß die Höcker als Pyramiden gestaltet sind von etwa ein Viertel

bis halber Höhe der Selbstklebeschicht. Die pyramidale Reliefstruktur führt zu einem extrem kleinen Berührungsraster mit einer hohen Anzahl an Haftspitzen. Erfindungsgemäß besteht ein vorteilhaftes Verfahren zur Herstellung der Selbstklebeschicht gemäß Anspruch 1 darin, daß die mit der klebstoffabweisenden Schicht ausgestattete Abdeckung an der Schichtseite in das höckerartige Oberflächenprofil verformt wird, anschließend die Oberflächenprofil-Vertiefungen mit dem entsprechend flüssigen Kleber ausgefüllend überlagert werden und daran anschließend die Fläche des Trägers auf die obere, freiliegende Klebstoffseite aufgebracht wird. Dabei wirkt die ohnehin erforderliche Abdeckung als die Klebeschicht profilierender Prägestempel, aber nicht allein dies, sondern auch als Übertragungswerkzeug für die an den Träger zu übergebende Selbstklebeschicht. Das alles kann rationell im Durchlaufverfahren erfolgen unter Einsatz von Walzen. Als Kleber kann auf solche mit einem Lösungsmittel zurückgegriffen werden oder auch auf sogenannte Hotmelt-Kleber. Die Transferbeschichtung läßt sich im letztgenannten Fall ebenfalls vorteilhaft erreichen. Die klebstoffabweisende Schicht (meist Silikon) trägt zur Prägnanz der Reliefstruktur bei; das Profilieren erfolgt nämlich von dieser Schichtseite der Abdeckung her durch Eindrücken.

Gegenstand und Verfahren sind nachstehend anhand eines zeichnerisch veranschaulichten Ausführungsbeispieles näher erläutert. Es zeigt

Fig. 1 die erfindungsgemäße Selbstklebeschicht mit Träger und Abdeckung, im einen Eckbereich voneinander aufgehoben,

Fig. 2 den Schnitt gemäß Linie II-II in Fig. 1,

Fig. 2a den entsprechenden Schnitt durch eine Selbstklebeschicht mit Träger herkömmlicher Art,

Fig. 3 den Schnitt gemäß Linie III-III in Fig. 1,

Fig. 3a einen entsprechenden Schnitt durch die bekannte Abdeckung,

Fig. 4 den Schnitt gemäß Linie IV-IV in Fig. 1 und

Fig. 4a wiederum einen entsprechenden Schnitt einer herkömmlichen Selbstklebeschicht mit Träger und Abdeckung.

Die dargestellte Selbstklebeschicht 1 dient als Mittel der Verbindung eines Trägers 2 mit einem nicht näher dargestellten Haftgrund. Bei einem solchen kann es sich um die Oberfläche von Textilien, Keramik, Verpackungskartons, Kunststoffkanistern und dergleichen handeln. Andererseits sind aber auch extrem glatte Flächen denkbar, wie bspw. Glasscheiben, Wandfliesen usw.

Bezüglich des Trägers 2 handelt es sich beim Ausführungsbeispiel um Haftetiketten, Poster oder dergleichen, also falt- und aufrollbare Flächenprodukte. Es kann sich aber auch um irgendwelche Formlinge oder Kunststoffspritzteile, wie bspw. Wandhaken mit Klebesockel, handeln.

Der aus Papier oder Kunststoff-Folie bestehende Träger 2 kann auf seiner Rückenfläche 3 bedruckt sein. Die andere mit 4 bezeichnete Fläche weist die Selbstklebeschicht 1 auf.

Die dem Träger 2 abgewandte Fläche 5 der-Selbstklebeschicht 1 ist höckerartig oberflächenprofiliert (das Bezugszeichen 5 erscheint auf der entsprechenden Darstellung gemäß Stand der Technik).

Die in enger Nachbarschaftslage angeordneten Höcker H weisen pyramidenförmige Gestalt auf. Die Basisflächen der Pyramiden grenzen aneinander. Es handelt sich zweckmäßig um Pyramiden mit quadratischer Basis. Diese stehen in Reihe, so daß senkrecht zueinander ausgerichtete, deutlich konturierte Kerbmulden 6 vorliegen.

Die Höhe x der Höcker H bzw. Pyramiden entspricht etwa einem Viertel bis einer Hälfte der Dicke y der Selbstklebeschicht 1. Die Höhe der Pyramiden entspricht etwa der Seitenlänge ihrer Basis. Die höckerartige Oberflächenprofilierung bringt eine insgesamt vergrößerte Klebefläche, wie sich aus dem Vergleich der Fig. 2 und 2a deutlich ergibt. Bei Aufbringen des Trägers 2 treten unter leichtem Andruck zunächst nur die Haftspitzen 7 mit dem Haftgrund in Kontakt. Dieser Bruchteil der Gesamt-Kleberhaftfläche eröffnet die Möglichkeit, die Position des Trägers zu verändern, also vor allem eine bessere Korrektur von falsch positionierten, großflächigen Folienaufklebern. Erst das willensbetonte Andrücken führt zu einer Beteiligung der Gesamt-Klebefläche, wobei bei rauhen Oberflächen die kleinen Höcker H auch noch formausfüllend in Art einer Verzahnung in die dortige rauhe Oberfläche eintreten. Ansonsten werden

nach dem endgültigen Aufbringen des Trägers 2 auf die gewünschte Fläche die Haftspitzen 7 durch den festen Andruck egalisiert.

Die geschilderte Oberflächenprofilierung läßt sich fertigungsgünstig in vorteilhafter Weise unter Benutzung der die Selbstkleberschicht 1 schützend überfangenden Abdeckung 8 realisieren. Es handelt sich um eine kompressible Papierschicht, die auf ihrer einen Seite noch mit einer besonderen klebstoffabweisenden Schicht 9 versehen ist. Diese besteht aus Silikon. Unter Ausnutzen der Kompressibilität der Abdeckung werden auf der silikonisierten Seite mit nicht scharfkantigen Werkzeugen, zweckmäßig Walzen, bis zu 400 Stück pro cm^2 Höcker gepreßt, und zwar entsprechend der erläuterten kerbtalartigen Vertiefungen von 0,005 bis 0,020 mm, wobei die Rückseite 10 der Abdeckung 8 glatt bleibt. Anschließend werden die so erzeugten Oberflächenprofil-Vertiefungen 11 mit dem entsprechend flüssigen Kleber ausfüllend überlagert. Diese bspw. aufgesprühte oder aufgerakelte Klebeschicht 1 ist in Fig. 3 in ihrer Dicke durch strichpunktierte Linien wiedergegeben. Nun erfolgt die Umlagerung der Selbstklebeschicht 1, so daß sie am Träger 2 haftet. Dabei tritt die freiliegende Klebstoffseite 1' gegen die Fläche 4 des Trägers 2, an der sie fest anhaftet. Es liegt die Situation gemäß Fig. 4 vor. Zur Ingebrauchnahme braucht nun lediglich die Abdeckung 8 abgezogen zu werden. Die das höckerartige Negativ-Oberflächenprofil aufweisende Abdeckung hinterläßt dabei einen stets formfrischen Abdruck in Form des höckerartigen Oberflächenprofils in der Selbstklebeschicht 1. Bei Abziehen ergibt sich sogar eine noch prägnantere Ausspitzung der Höcker H (siehe Fig. 2).

Andererseits liegen die Höcker H bzw. ihre Haftspitzen 6 auch bei einem Wickelprozeß oder bei Stapeldruck geschützt zwischen dem Träger 2 und der Abdeckung 8.

Die aufgrund der Reliefstruktur erzielte Klebstoffeinsparung ergibt sich aus Fig. 4. Die Dicke des Fertigprodukts nimmt um das Maß z gegenüber der eines herkömmlichen ab. Das Maß z entspricht etwa der Höckerhöhe x.

Alle in der Beschreibung erwähnten und in der Zeichnung dargestellten neuen Merkmale sind erfindungswesentlich, auch soweit sie in den Ansprüchen nicht ausdrücklich beansprucht sind.

FIG. 2a

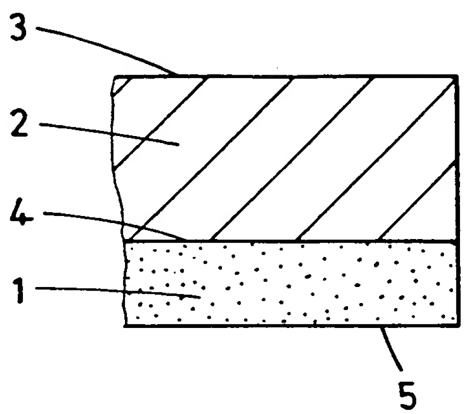


FIG. 2

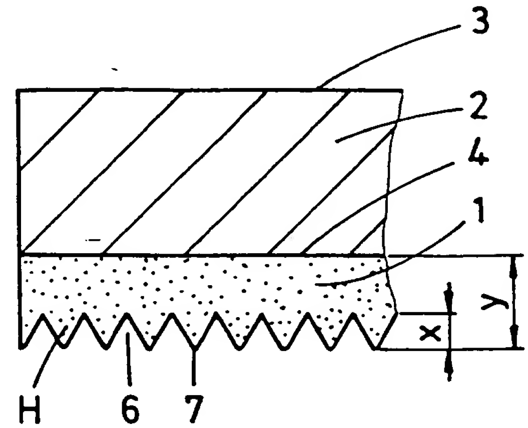


FIG. 3a

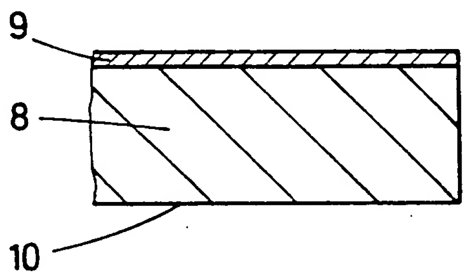


FIG. 3

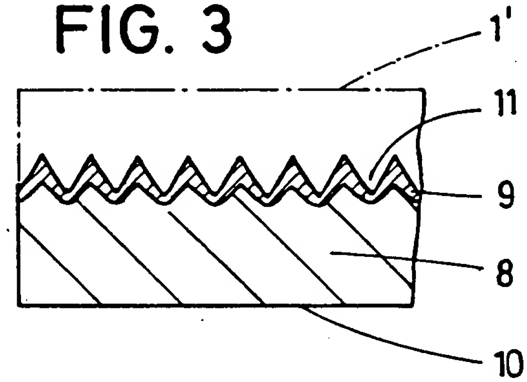


FIG. 4a

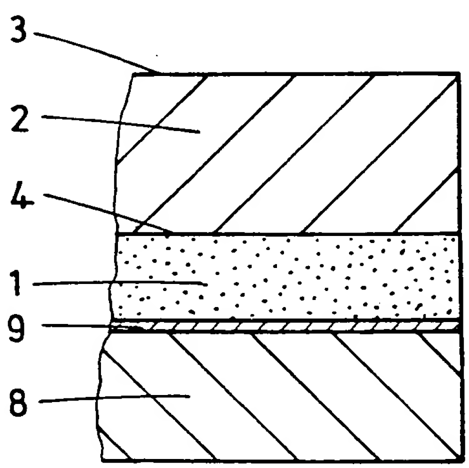
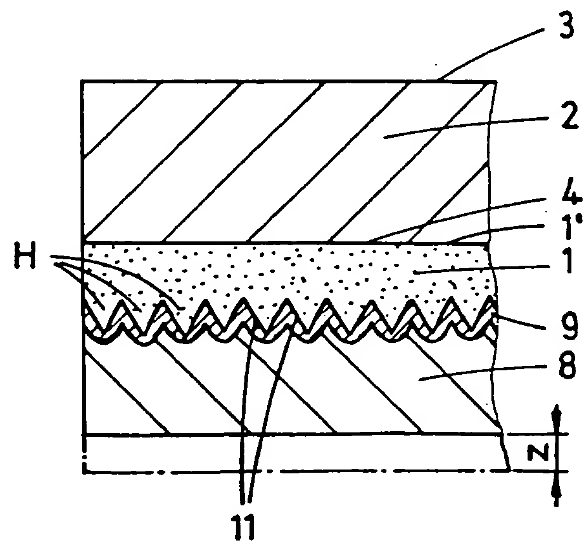
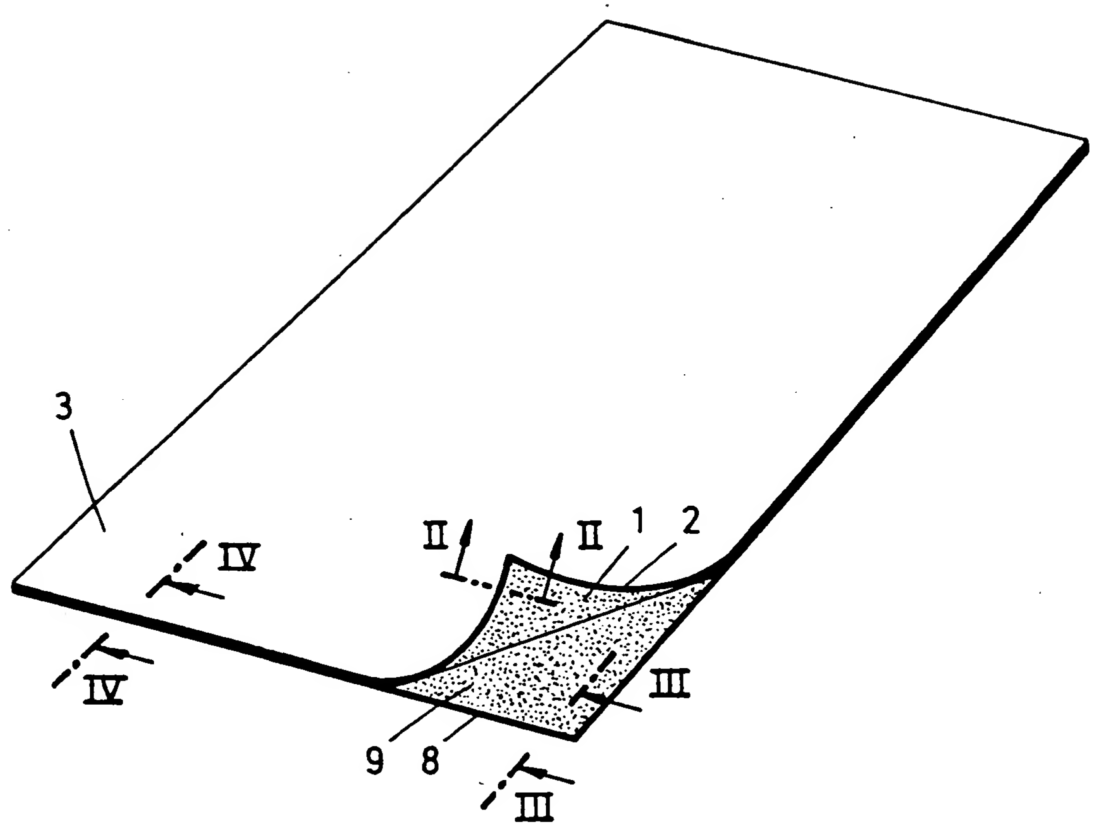


FIG. 4



Nummer: 34 17 746
Int. Cl.⁴: C 09 J 7/02
Anmeldetag: 12. Mai 1984
Offenlegungstag: 14. November 1985

FIG. 1



PATENT APPLICATION DE 34 17 746 A1

Jackstädt GmbH
Bembergstrasze 2
5600 Wuppertal 1
Germany

Self-Adhesive Layer with a Cover Arranged on the Side Facing Away from the Carrier

Patent claims

1. Self-adhesive layer with a cover, arranged on the side facing away from the carrier, that has an adhesive-repellent layer located between the self-adhesive layer and the cover, characterized in that the surface (5) of the self-adhesive layer (1) facing away from the carrier (2) has a jagged surface profile.

2. Self-adhesive layer according to claim 1, characterized in that the bumps (H) have a pyramidal or conical shape of about 1/4 to 1/2 of the height of the self-adhesive layer (1).

3. Method for the production of a self-adhesive layer according to claim 1, characterized in that the cover (8) equipped with the adhesive-repellent layer (9) is deformed on the layer side into the jagged surface profile; that subsequently the recesses (11) of the surface profile are filled and overlaid with the appropriately liquid adhesive; and that, immediately afterwards, the surface (4) of the carrier (2) is applied to the upper, exposed adhesive side (1').

4. Method according to claim 3, characterized in that the cover (8) is provided with its surface profile by impression from the coated side.

Description

The invention relates to a self-adhesive layer with a cover, arranged on the side facing away from the carrier, that has an adhesive-repellent layer between the self-adhesive layer and the cover. A self-adhesive-coated flat-shaped product is known whose adhesive hardens with a time delay whereby sufficient time remains for a possibly required positional correction.

In addition, repositionable carriers for imprints or so-called posters are known whose self-adhesive layer contains two components. The one, as it were, produces a temporary bond while the final adhesive attachment takes place by the destruction of micrometrically small individual receptacles that contain a second component, which causes the final hardening.

Those kinds of receptacles break if a stronger pressure is exerted on the carrier. Both solutions require special adhesives and, accordingly, expensive production measures.

It is the task of the invention to indicate a generic self-adhesive layer whose efficiency neither depends on a special time factor nor requires the use of special combinations of adhesives, but nevertheless allows a removal--for instance, to perform positional corrections of the carrier--without any detriment to the final adhesive effect. This problem is solved according to the invention in that the surface of the self-adhesive layer facing away from the carrier has a bumpy surface profile.

As a consequence of this kind of development, a generic self-adhesive layer is created with an increased utility value: The rough surface profile of the self-adhesive layer provides a repositioning option with very simple means.

Only the free ends of the jags establish contact with the adherent surface, if only a light pressure is exerted. The adhesive contact comprises only a small fraction of the adhesive surface that can be activated by heavier pressure. Because of the relief structure, the actively adhesive surface is even considerably enlarged.

This has a favorable effect if, for instance, adhesive labels must be attached to rough surfaces of textiles, ceramic, packaging cardboards, plastic canisters, or the like. An indenting interlock that is staggered in depth occurs while the recesses of the roughening are being filled. In addition, a substantial reduction of the coating amount of the self-adhesive layer results, whereby a lowering of the production costs is attained.

A jagged surface profile also favors stockpiling in a coil form; the tensions are practically compensated for in the relief structure.

The surface profile can be designed in a geometrically uniform structure or with an uneven distribution of the jags, which can be advantageous for specific application purposes--for instance, when the product should be principally attuned to improved adhesion to rough, therefore, irregularly structured surfaces.

An especially favorably relief structure is obtained in such a manner that the jags are shaped like pyramids of about 1/4 to 1/2 the height of the self-adhesive layer. The pyramidal relief structure leads to an extremely small contact raster with a high number of adhesive tops.

According to the invention, an advantageous process for the production of the self-adhesive layer according to claim 1

consists in that the cover equipped with the adhesive-repellent layer is deformed, on the layer side, into the jagged surface profile; the surface-profile recesses are filled with a layer of appropriately liquid adhesive; and, immediately afterward, the surface of the carrier is applied to the upper, exposed adhesive side.

In the process, the cover, which is necessary anyhow, acts as the adhesive layer of profile-shaping stamp dies, but not only this; it also functions as the transfer tool for the self-adhesive layer to be transferred to the carrier. All this can take place efficiently in a continuous process with the use of rollers.

For adhesives, one can fall back on those with a solvent or also on so-called hot-melt adhesives. The transfer coating can also be attained advantageously in the last-mentioned case. The adhesive-repellent layer (mostly silicone) contributes to the precision of the relief structure; the profiling, namely, takes place by impression from the layer side of the cover.

In the following, the object and the method are explained in more detail using a construction example illustrated in drawings.

Shown are:

Fig.1 The self-adhesive layer according to the invention with carrier and cover, raised in a corner area;

Fig.2 The section along line II-II in Fig. 1;

Fig.2a The corresponding section through a self-adhesive layer with a carrier of the conventional type;

Fig.3 The section along line III-III in Fig. 1;

Fig.3a A corresponding section through the familiar cover;

Fig.4 The section according to line IV - IV in Fig. 1; and

Fig.4a Again, a corresponding section of a conventional self-adhesive layer with carrier and cover.

The represented self-adhesive layer (1) serves as a means for connecting a carrier (2) with an adherent surface that is not represented in more detail. In the latter case, it can concern the surface of textiles, ceramic, packaging cardboards, plastic canisters, and the like. But, on the other hand, also extremely smooth surfaces are conceivable, such as, for instance, glass panes, wall flags, etc.

With respect to the carrier (2), the construction examples concern adhesive labels, posters, or the like--thus, foldable and windable flat-shaped products.

However, it can also concern any type of blank or molded plastic article such as, for instance, wall hooks with adhesive sockets. The carrier (2) consisting of paper or plastic film can be imprinted on its back surface (3). The other surface indicated with (4) has the self-adhesive layer (1).

The surface (5) of the self-adhesive layer (1) facing away from the carrier has a jagged surface profile (the reference number 5 appears on the corresponding representation according to the state of technology).

The jags (H) arranged in close adjacent position have a pyramidal shape. The base surfaces of the pyramids border on each other. Advisedly, they are pyramids with a square base. They are arranged in rows with the result that clearly contoured notched troughs (6) are present, aligned perpendicular to each other.

The height **x** of the jags (H) or pyramids corresponds to about 1/4 to 1/2 of the thickness **y** of the self-adhesive layer (1). The height of the pyramids corresponds approximately to the side length of their base. The jagged surface profile provides an overall enlarged adhesive surface, as appears clearly from a comparison of Fig. 2 and 2a.

During the application of the carrier (2), first only the adhesive tops come in contact with the adherent surface, under light pressure. This fraction of the total adhesive surface opens the possibility of changing the position of the carrier--thus, above all, a better correction of erroneously positioned large-surface film labels.

Only deliberate pressure leads to a participation of the entire adhesive surface whereas, with rough surfaces, the small jags (H) also enter into the rough surface, filling the contour in the manner of an indentation. Otherwise, the adhesive tops (7) are equalized by firm pressure, after the final application of the carrier (2) to the desired surface.

The described surface profile can be realized advantageously during the production with the use of the cover (8), which provides a protective flash to the self-adhesive layer. It concerns a compressible paper layer that, on one of its sides, is provided with a special adhesive-repellent layer (9). The latter consists of silicone.

Exploiting the compressibility of the cover, up to 400 jags per cm^2 are pressed on the siliconized side with tools that are not sharp edged--advisedly, rollers--corresponding to the explained groove-like recesses of 0.05 to 0.020 mm, whereas the backside (10) of the cover (8) remains smooth. Immediately afterward, the recesses (11) of the surface profile produced in that manner are filled with the appropriately liquid adhesive.

This adhesive layer (1)--which is, for instance, sprayed on or spread on--is represented in Fig. 3 in its thickness by interrupted lines.

Now the rearrangement of the self-adhesive layer (1) takes place, with the result that it adheres to the carrier (2). In the process, the exposed adhesive side (1') is placed against the surface (4) of the carrier (2), to which it adheres firmly. Now the situation according to Fig. 4 is present. For practical use, solely the cover (8) needs to be pulled off.

The cover, which has the jagged negative surface profile, leaves an always fresh impression in the form of a jagged surface profiile in the self-adhesive layer (1). An even more precise pointing of the jags (H) results during the removal (see Fig. 2). On the other hand, the jags (H) or their adhesive tops (6) lie protected between the carrier (2) and the cover (8), also in a winding process or under the stress of a pile.

The saving of adhesive attained because of the relief structure becomes apparent from Fig. 4. The thickness of the finished product decreases by dimension **z**, compared to that of a conventional product. The dimension **z** corresponds approximately to the height **x** of the jags.

All the new features mentioned in the description and represented in the drawing are essential for the invention, even if they are not expressly claimed in the patent claims.

Translator: Joseph J. Vaes
612-738-7605

PATENT APPLICATION DE 35 37 433 A1

Nichiban Co., Ltd.
Tokio, Tokyo
Japan

Removable Adhesive Sheet

Abstract

The invention describes a removable adhesive sheet that has a carrier (A) and an adhesive layer which, in turn, contains elastic microspheres (B) and an adhesive material (C) and is developed on a surface of the carrier that holds it, whereas the mixing ratio of the elastic microspheres (B) to the adhesive material (C) in the adhesive layer is 1:10 to 10:1, relative to the weight, and the protruding surface areas of the elastic microspheres (B), which partially protrude from the surface of the adhesive layer, are completely covered with the adhesive material (C).

The adhesive strength of the removable adhesive sheet according to the invention is not reduced by frequent repetition of the adhesion to and removal from a part to which it was glued or from an adhesive surface.

Patent claims

1. Removable adhesive sheet that has a carrier (A) and an adhesive layer, characterized in that the adhesive layer contains elastic microspheres (B) and adhesive material (C) and is formed on a surface of the carrier that supports it, whereas the mixing ratio of the elastic microspheres (B) to the adhesive (C) in the adhesive layer is 1:10 to 10:1, relative to the weight, and the protruding areas of the elastic microspheres protruding partially from the surface of the adhesive layer are completely covered with the adhesive (C).

2. Removable adhesive sheet according to claim 1, characterized in that the particle diameter of the elastic microspheres (B) in the adhesive layer is 0.1 to 1000 μm.

3. Removable adhesive sheet according to claim 1, characterized in that the thickness of the adhesive layer is 0.1 to 100 μm.

4. Removable adhesive sheet according to claim 1, characterized in that 100 to 1,000,000 units/cm^2 of the elastic microspheres (B) are distributed on the surface of the carrier that forms the adhesive layer.

5. Removable adhesive sheet according to claim 1, characterized in that the adhesive layer forms separate areas distributed over the surface of the carrier (A) that supports it, and the surface portion of the adhesive-layer areas is 20-98% of the surface supporting the adhesive layer.

6. Removable adhesive sheet according to claim 1, characterized in that the mixing ratio of the elastic microspheres (B) to the adhesive (C) in the adhesive layer is 1:5 to 5:1.

7. Removable adhesive sheet according to claim 2, characterized in that the particle diameter of the elastic microspheres (B) is 0.5-300 μm.

8. Removable adhesive sheet according to claim 3, characterized in that the thickness of the adhesive layer is 1-30 μm.

9. Removable adhesive sheet according to claim 4, characterized in that the elastic microspheres (B) are distributed on the surface of the carrier (A) that forms the adhesive layer in a quantity of 1000 to 150,000 units/cm^2 of the surface.

10. Removable adhesive sheet according to claim 5, characterized in that the surface portion of the adhesive-layer areas is 20-90% of the surface of the carrier (A) supporting it.

11. Removable adhesive sheet according to claim 1, characterized in that the carrier (A) is a fibrous material or a film with a smooth surface.

12. Removable adhesive sheet according to claim 1, characterized in that the elastic microspheres (B) are produced with the use of high-molecular polymers whose glass transition temperature ranges from -80°C to 10°C.

13. Removable adhesive sheet according to claim 12, characterized in that the high-molecular polymers are selected from a chain polymer, a graft polymer, a block polymer, and a three-dimensional cross-linked polymer.

<u>Background of the invention</u>

The invention relates to a removable adhesive sheet--especially a repeatedly removable and repeatedly bonding self-adhesive sheet, whose adhesive force does not decrease with a frequent repetition of adhesion and removal from different objects to which it was glued (attachment surfaces)--and also to sheet-like structures with these kinds of properties.

A conventional self-adhesive sheet or adhesive tape was generally produced by coating the surface of a carrier consisting of paper, plastic, or metal that forms an adhesive layer with an adhesive material.

However, in that kind of a sheet, the surface forming an adhesive layer was smoothly coated over its entire surface with the adhesive material, which makes possible bonding of the sheet to an object, adherent surface, or bonding base but does not allow repeated removal and re-adhesion to the same or to another object.

The reason for this is the so-called surface bonding of the adhesive sheet to the adherent object that results in the adherent object being partially pulled off to cover the surface of the adhesive material or, conversely, results in that, upon removal of the sheet, the adhesive material partially remains on the adherent object, which leads to a considerable reduction of the adhesive force of the adhesive sheet with repeated adhesion and removal of the same.

Therefore, different adhesive sheets were developed with so-called point bonding instead of surface bondings. Those kinds of sheets can again be removed because the surfaces of the adhesive layers are made uneven or because the surfaces of the sheet that come in contact with the adherent objects are reduced by other methods.

The following are examples for those kinds of removable adhesive sheets: A sheet in which the adhesive is applied in lines or dots (compare Japanese temporary utility-model publication numbers 67060/1973, 54546/1984, and 133641/1984); a sheet whose adhesive layer itself has been developed uneven (compare Japanese temporary utility-model publication numbers 17561/1975 and 44750/1984); and a sheet on whose substrate an uneven area is developed and on which an adhesive material has been applied (compare Japanese temporary utility-model publication numbers 116453/1974 and 135474/1978, Japanese utility-model publication numbers 4460/1976 and 3396/1977; Japanese temporary utility-model publication number 45340/1983 and USA patent number 3 386 846).

The adhesive sheets described above can be adhered and removed again several times. However, in those kinds of adhesive sheets, the effective surface that comes in contact with an adherent object is reduced only for the purpose of facilitating the removal of the sheet; therefore, the adhesive force with which that kind of a sheet adheres to an adherent object (adhesion surface), is unsatisfactory.

In addition, the adhesive material itself, which can come in contact with the adhesion surface at the protruding parts of the uneven surfaces of the adhesive sheet, is physically removed as such and, therefore, that kind of adhesive sheet becomes unusable when it has been adhered to an adherent object and removed from it only a few times.

Description of the invention

By the invention, a repeatedly removable and repeatedly adhering adhesive sheet should be created whose adhesive strength is not reduced by a frequently repeated adhesion to or removal from an adherent object (an adhesion surface).

This problem is solved according to the invention by a removable adhesive sheet that has a carrier (A) and an adhesive layer that, in turn, contains elastic microspheres (B) and an adhesive material (C) and is developed as an adhesive layer on a surface of the carrier, whereas the mixing ratio of the elastic microspheres (B) to the adhesive material (C) in the adhesive layer is 1:10 to 10:1, relative to the weight ratio, and the elastic microspheres (B) partially protrude from the surface of the adhesive layer, and these protruding parts of the elastic microspheres (B) are completely covered by the adhesive material (C).

The essential characteristics of the invention consist, namely, in that an adhesive layer, composed of elastic microspheres and an adhesive material in a specific ratio, is developed on a carrier, and the parts of the elastic microspheres that protrude from the surface of the adhesive layer are completely covered by the adhesive.

In the following, the invention is further explained by the description of preferred embodiments with reference to the attached drawing. Shown are:

Fig. 1 A top view of a removable adhesive sheet according to the invention;

Fig. 2 An enlarged cross-section of Fig. 1 along line X-X;
Fig. 2-1 A modified example of Fig. 2;
Fig. 2-2 Another modified example of Fig. 2;

Fig. 3-7 Top views of removable adhesive sheets, according to the invention, whose adhesive layers have the form of squares (Fig. 3), circles (Fig. 4), ellipses (Fig. 5), triangles (Fig. 6), or pentagons (Fig. 7);

Fig. 8-11 Top views of removable adhesive sheets, according to the invention, whose adhesive layers are developed, at the upper end of the carrier, in the form of squares (Fig. 8), wavy bands (Fig. 9), serrated bands (Fig. 10), or rhombs (Fig. 11).

A removable adhesive sheet, according to the invention, is a sheet that has a carrier--which can be inscribed by hand, or imprinted--and an adhesive layer developed thereupon, and that can be repeatedly adhered at any place that is most suitable for a user.

A typical embodiment of the removable adhesive sheet according to the invention is shown in Fig. 1 and 2.

Fig. 2-1 is a modified example of Fig. 2--namely, an enlarged cross-section (of Fig. 1, along line X-X) in the case in which a base coat layer (6) (bonding-agent- or primer layer) and a release-agent layer (7) are used. Fig. 2-2 is an enlarged cross-section in the case of layer- or stack-wise superimposed adhesive sheets in which the base-coat layer (6) and the release-agent layer (7) are present.

As these figures show, in an adhesive sheet according to the invention that has, on the carrier (1), a base coat layer and, on this, an adhesive layer (2) (layer of an adhesive composition), the surfaces of the elastic microspheres (3) that protrude from the surface of the adhesive layer (2) are completely covered by the adhesive (4). In this manner, the elastic microspheres (3) make protrusions in the adhesive layer (2).

As Fig. 2, 2-1, and 2-1 show, the adhesive layer can touch the carrier (1) or the base coat layer (6) which, in turn, adheres to the carrier (1).

In the adhesive sheet according to the invention, usually a fibrous material such as paper, cloth, a non-woven material, etc. are used as a carrier (A). In addition, also a film with a smooth surface can be used--such as polyethylene-, polypropylene-, polyester-, polyvinyl chloride-, cellulose acetate-, polycarbonate-, cellophane-, polyvinyl idene fluoride-film, and the like, as well as a substrate made from it.

The entire surface of one side of that kind of a substrate is used as a substrate for the adhesive layer, and an adhesive composition containing elastic microspheres and an adhesive material is applied to this carrier surface. If the adhesive-layer mixture is applied to the substrate surface, an etching primer can be used on the surface of the substrate (A) to increase the strength of the bonding between the adhesive layer and the carrier, as is common practice.

Furthermore, a release-agent layer can be used, if needed, on the opposite side of the substrate (opposite the side on which the adhesive layer is applied). In the case that the adhesive sheets are superimposed or stacked in several layers, each adhesive sheet can thus be easily removed. On the opposite side of the substrate, also an imprintable or imprinted layer can be provided.

The elastic microspheres (B), which are one of the components of the adhesive mixture, serve to enlarge the contact surface of the adhesive layer with an adherent part or an adherent surface if the adhesive sheet according to the invention is adhered to it.

The elastic microspheres protrude from the surface of the adhesive layer as long as the adhesive sheet is not adhered to an object, and the microspheres are elastically deformed when the adhesive sheet is adhered to the object under pressure, with the result that larger surface areas of the adhesive layer can be adhered to the object.

In this manner, the adhesive sheet according to the invention has a greater adhesive strength than would be the case in a common so-called point adhesion.

In addition, the elastic microspheres themselves have a restoring force that prevents the bonding of the adhesive sheet to an object from becoming too strong. Owing to this, the adhesive sheet according to the invention can also easily be removed again from an object to which it was attached.

The elastic microspheres (B) can have, or not have, the capacity for self-adhesion. In any case, the microspheres have to be elastic bodies.

Accordingly, usually high molecular polymers whose glass transition temperature lies in the range of -80°C to 10°C can be used as elastic microspheres. A copolymerizate such as a chain polymer, a graft polymer, or a block polymer; a three-dimensionally cross-linked polymer; etc. can be used with preference as that kind of high-molecular polymer.

According to the invention, copolymers can be used that are obtained, for instance, from 90-99.9 parts by weight of a (meth)acrylic ester and 0.1-10 parts by weight of an α-olefinic carboxylic acid; from copolymers that are obtained from 2-ethylhexylacrylate/acrylic acid = 98/2, isononylmethacrylate/acrylic acid = 97/3, isononylacrylate/methacrylic acid = 96/4; from n-octyl acrylate/methacrylic acid = 99/1 (in which the indicated ratios relate to the weight); and the like, as well as cross-linked copolymers of the same.

The following should be mentioned here, in particular, as examples of (meth)acrylic esters: Ethyl acrylate, n-propyl acrylate, n-butyl acrylate, isobutyl acrylate, n-octyl acrylate, iso-octyl acrylate, 2-ethylhexyl acrylate, n-nonyl acrylate, isononyl acrylate, lauryl acrylate, methyl methacrylate, ethyl methacrylate, n-propyl methacrylate, n-butyl methacrylate, 2-ethylhexyl methacrylate, isononyl methacrylate, and lauryl methacrylate.

As an example of 2-mono-olefinic carboxylic acid should be mentioned, in particular, an acrylic acid, a methacrylic acid, an itaconic acid, and a crotonic acid.

The following should be mentioned, by way of example, as polymers that can be used here: A carboxyl-modified cross-linked polymer of liquid polyisoprene, a cross-linked polymer of liquid polybutadiene with an hydroxyl group at both ends, a cross-linked polymer of polybutadiene with a carboxyl group, a polymer of a polyoxyalkylene compound with an alkoxyl group at both ends, natural rubber, styrene-butadiene rubber, polyisoprene, styrene-isoprene-styrene block copolymer, styrene-ethylene-butylene-styrene copolymer, etc.

Commonly used as elastic microspheres (B) containing a copolymer as indicated above are those with a particle dimension of 0.1-1000 μm--preferably, 1-100 μm (the average particle size usually is 0.5-300 μm, preferably 1-100 μm). Microspheres with that kind of diameter can be obtained by suspension polymerization in an aqueous medium.

The adhesive material (C), which is the other component of the adhesive mixture, serves to connect the substrate (A) with an object and must be tacky at normal temperature. As examples of that kind of an adhesive should be mentioned, for instance: An adhesive of the polyacrylic ester copolymer series, an adhesive of the polyisobutylene series, an adhesive of the styrene-ethylene-butylene-styrene block copolymer series, and the like.

The above mentioned elastic microspheres (B) and the adhesive material (C) are combined into an adhesive mixture in a weight ratio of 1:10 to 10:1--preferably, 1:5 to 5:1.

If the weight ratio of the microspheres to the adhesive material in the formulation is too small--for instance, smaller than 1/10 --the microspheres protrude only slightly from the surface of the adhesive layer, and the adhesive layer becomes almost smooth, with the result that the removal of the adhesive sheet from an object to which it was attached becomes difficult.

If, on the other hand, the ratio is too large--for instance, more than 10/1--the surface of the parts of the microspheres protruding from the surface of the adhesive layer cannot be completely covered by the adhesive material, which makes a secure adhesion of the adhesive sheet to an object to which it is attached more difficult.

An adhesive mixture that contains the above-mentioned components can be produced by dispersing a specified amount of the elastic microspheres and an adhesive material in a volatile organic solvent and stirring the obtained mixture until it is homogeneous.

An adhesive sheet according to the invention can be obtained by coating the surface of the substrate where the adhesive layer should be developed with that kind of homogeneous liquid dispersion.

As examples of a volatile organic solvent should be mentioned: toluene, n-hexane, n-heptane, cyclohexane, ethyl acetate, methylethyl ketone, etc. Preferably, the concentration of the microspheres and the adhesive material in the liquid preparation of the adhesive mixture lies in the range of 5-40% by weight to cover the entire surfaces of the microspheres with adhesive.

The liquid preparation can be applied to the surface of the substrate that forms the adhesive layer in such a manner that the thickness of the adhesive layer after the removal of the organic solvent is usually 0.1 to 100 μm--preferably, 1-30 μm.

As examples of coating methods, the following should be mentioned: a knife coating, a gravure spread-coating process, a spray-coating process, or a screen-printing process. If the above-mentioned mixed liquid preparations are used in any of these procedures, the protruding parts of the microspheres are reliably covered with the adhesive during the coating.

Preferably, the liquid preparation is applied in such a way that 100-1,000,000 units/cm^2--preferably 1000 to 150,000 units/cm^2--of the elastic microspheres are uniformly distributed on the surface of the adhesive layer formed on the substrate. Although the removability of an adhesive sheet depends on the diameter of the elastic microspheres, it decreases however when the number of elastic microspheres is less than 1000 units/cm^2.

If, on the other hand, the number of elastic microspheres is too large, they are so densely distributed that, during the application of an adhesive sheet with pressure to an object, adjacent microspheres interfere with each other and prevent their desired visco-elastic deformation, with the result that the balance of bonding and removability is interfered with. For instance, in case the average particle diameter of the microspheres is about 30 μm, the number of microspheres is preferably 150,000 units/cm^2 or less, for practical purposes.

In an adhesive sheet according to the invention, the surface of the adhesive layer can be subdivided into a part of the adhesive that has a high adhesive strength and parts of highly visco-elastic microspheres protruding from the layer but whose protruding surfaces are also covered with the adhesive.

Because the adhesive strength of the protruding parts of the microspheres that actually come in contact with the object is stronger because of the adhesive material that covers them--than would be the case if the protruding surfaces of the microspheres were not covered with adhesive--the number of microspheres per unit area of the substrate can be clearly reduced. Accordingly, an adhesive sheet according to the invention shows excellent bonding, even when microspheres are distributed with those kinds of lower densities as described above.

On the other hand, the adhesive layer can also be divided into specified island-like patterns with the result that microspheres are densely available from area to area. In this case, the total number of microspheres is small but, during the actual adhesion, an ideal bonding and removability is obtained because the microspheres are combined with a preferred density in the island-like parts.

Accordingly, the number of microspheres themselves that form the protruding parts, which come into actual contact with the object to which they are adhered, can be relatively small. Therefore, it is effective to distribute the elastic microspheres in the above-mentioned range, to confer to the adhesive sheet a particularly excellent repeated adhesive strength and removability.

A removable adhesive sheet according to the invention can be produced by coating a substrate with a specified amount of the above-mentioned preparation that contains microspheres and an adhesive material, and drying the substrate for 0.1 - 10 minutes, usually at 50-140°C, to remove the organic solvent. During this process, it is advisable and effective to use hot air for the drying, to reduce the drying time.

Usually, the adhesive layer is developed on the surface of one side of a substrate over its entirety or over a part of this surface. When the adhesive layer is formed on one end of the substrate, the rest of the substrate can be used as a handle, which facilitates the removal of the sheet.

In addition, an adhesive layer can be applied to the entire surface of a substrate that is suitable for it. However, preferably only 20-98% of the carrier surface is coated with the mentioned adhesive mixture.

More preferably, an area of 20-90% of the surface is coated with the adhesive mixture. The reason that the adhesive mixture is not formed over the entire surface of the carrier is that, as mentioned above, the parts of the elastic microspheres that protrude from the surface of the adhesive layer are covered with the adhesive, according to the invention, and, therefore, the adhesive force on the part to which it is attached becomes too strong when the substrate surface is completely covered with an adhesive layer.

Therefore it is preferred, according to the invention, to develop an adhesive layer on the surface of the carrier in the surface proportion mentioned above.

To develop an adhesive layer in that kind of surface proportion, the adhesive layer (2)--as shown in Fig. 3-7--is preferably applied to a number of surfaces that are distributed over the surface (5) of the substrate to accept the adhesive layer.

The patterns can have the form, for instance, of a square (Fig. 3), a circle (Fig. 4), an ellipse (Fig. 5), a triangle (Fig. 6), a pentagon (Fig. 7), etc.

The form of a pattern in which the adhesive layer is formed is not specifically restricted if the adhesive layer can be developed on the suitable surface of the carrier within the above-mentioned surface proportion.

Fig. 8-11 show, in each case, an embodiment in which an adhesive layer is developed at the upper end of the carrier surface (5) of the substrate, within the above-mentioned percentual surface portion.

In these figures, Fig. 8 shows an embodiment in which the adhesive layer is formed with the use of a square pattern, as shown in Fig. 3. Fig. 9 shows an embodiment in which the adhesive layer is formed in a pattern of wavy lines. Fig. 10 shows an embodiment in which the underside of the adhesive layer is developed on the carrier surface in an indented pattern; Fig. 11 shows an embodiment in which the adhesive layer is provided in an interrupted rhomb pattern.

The adhesive sheet according to the invention can be repeatedly adhered to an object such as paper, cloth, plastic, metal, earthenware, porcelain, glass, coated metal, etc., and again be removed from it, and can be used as a memo blocks, drawing paper, notebooks, coupons, price stickers, labels for samples, etc.

The adhesive layer according to the invention is formed, as described above, with the use of an adhesive mixture in which elastic microspheres and adhesive materials are combined in such specified ratio that the parts of the elastic microspheres protruding from the surface of the adhesive layer are covered with the adhesive. Accordingly, the adhesive force with which the adhesive layer adheres to the particle to which it is attached is substantially larger than would be the case if the protruding parts of the microspheres were not covered with adhesive.

Therefore, according to the invention, not only the density of the used elastic microspheres, but also the surface of the adhesive layer to be formed themselves, can be reduced. This leads to a savings in adhesive mixture, and a removable adhesive sheet that can be repeatedly adhered and removed can be produced at low cost. In addition, despite its low cost, the adhesive sheet according to the invention has an excellent capacity for repeated adhesion/removal.

The invention will be further explained by the following construction examples which, however, should not be understood as restricting.

Example 1

A homogeneous liquid dispersion was produced by dispersing 70 parts by weight of a copolymer of isononylacrylate/acrylic acid = 97/3 (weight ratio) as elastic microspheres with an average diameter of 30 μm; 30 parts by weight of a copolymer of isononyl acrylate/butyl acrylate/acrylic acid = 44/54/2 (weight ratio), and 0.1 part by weight of toluene di-isocyanate as an adhesive material in 10% by weight of toluene; and the dispersion obtained in this manner was applied to the surface of 70 g of wood-free paper by means of a knife-coating device, with the result that, after the drying, a coating of about 15 g/m^2 was obtained.

Furthermore, a heat treatment was applied for 5 minutes at 120°C to obtain a removable adhesive sheet. The adhesive force of this adhesive sheet, measured according to the Japanese industrial standard JIS-Z-1523, was 88 g/cm.

Then the adhesive sheet obtained in that manner was adhered to newsprint and then slowly removed from it. In the process, no fibers were pulled off the newsprint. After repeating the adhesion (2) and the removal from the wood-free paper 50 times, the adhesive strength of the adhesive sheet was damaged very little.

If, furthermore, the adhesive sheet, treated as mentioned above, was adhered to newsprint attached to a wall, the adhesive sheet did not drop off, even after the course of 1 day.

The condition of the adhesive and of the elastic microspheres on the adhesive sheet was observed with the use of a microscope. The observation confirmed a structure in which the elastic microspheres were almost uniformly distributed in a single layer on the wood-free paper, whereas its protruding surfaces were covered with the adhesive.

The distribution density of the elastic microspheres per unit area was minimally about 18,000 units/cm^2, maximally about 34,000 units cm^2 and, on average, about 26,000 units/cm^2. The surface portion of the adhesive layer relative to the surface of the carrier destined to accept it was almost 100%. The thickness of the adhesive material covering the elastic microspheres was about 1 μm in the thinnest areas and about 25 μm in the thickest areas.

Comparison example 1a

A homogeneous liquid dispersion was produced by dispersing the same adhesive material as used in example 1--that is, 100 parts by weight of a copolymer of isononyl acrylate/butylacrylate/ acrylic acid = 44/54/2 (weight ratio) and 0.1% by weight of toluene diisocyanate in 10% by weight of toluene, and the solution obtained in this manner was applied to the surface of

70 kg of wood-free paper by means of a knife-coating device--with the result that the amount applied to it was about 10 g/m^2, after drying--and further heat treated for 5 minutes at 120°C to obtain an adhesive sheet. The adhesive force of the adhesive sheet, measured according to the Japanese industrial norm JIS-Z-1523, was 204 g/cm.

When the adhesive sheet obtained in that manner was adhered to newsprint and again slowly removed from it, the fibers of the newsprint were pulled off in great quantity. In addition, the adhesive sheet showed a very minimal adhesion when adhered again. Adhesion and removal were repeated on a wood-free paper and, from about the 15th repetition, no adhesion of the surface of the adhesive could be felt any longer. After repeating the adhesion and removal 20 times, the adhesive sheet was adhered to newsprint that was attached to a wall. The adhesive sheet dropped off within one minute.

The condition of the adhesive on the adhesive sheet was examined using a microscope. A uniformly smooth adhesive layer was observed, and the percentual surface portion of the adhesive layer relative to the underlying carrier surface was 100%.

From the results mentioned above, it follows clearly that the structure according to the invention, in which the surfaces of the elastic microspheres are covered with the adhesive, results in an ideal adhesion and removability.

Example 2

A homogeneous liquid dispersion was produced by dispersing 70 parts by weight of the same polymer as in example 1 in the form of elastic microspheres, 30 parts by weight of the same copolymer as use in example 1, and 0.1 part by weight of toluene diisocyanate as adhesive material in 8% by weight of toluene, and the solution obtained in this manner was applied through a gauze-wire screen to the surface of 70 kg of wood-free paper, by means of a knife-coating device--with the result that the amount applied was about 5 g/m^2, after drying--and further subjected to a heat treatment for 5 minutes at 120°C to obtain a removable adhesive sheet.

The adhesive force of this adhesive sheet, measured according to the Japanese industrial standard JIS-Z-1523 was 80 g/cm.

When the obtained adhesive sheet was adhered to newsprint and then again slowly removed from it, the fibers of the newsprint were not pulled off. After repeating the adhesion to and the removal from a wood-free paper 50 times, the adhesive strength of the adhesive sheet was then adhered to newsprint attached to a wall, the sheet did not drop off, not even after one day.

The condition of the adhesive and of the elastic microspheres on the adhesive sheet was examined using a microscope. A structure was observed in which the adhesive layer on the wood-free paper was formed in a pattern of circles with a radius of 300 μm and in which almost a single layer of elastic microspheres was coated with the adhesive. The percentual surface portion of the adhesive layer relative to the underlying carrier surface was about 28%. The number of elastic microspheres per unit area was minimally about 4,900 units/cm^2, maximally about 10,300 units/cm^2 and, on average, about 8,500 units/cm^2.

Therefore, the applied quantity of the adhesive was reduced to 1/3 and also the number of elastic microspheres was reduced to 1/3 in comparison with the case in which the percentual surface portion of the adhesive layer relative to the underlying carrier surface was 100%. However, the adhesion of the adhesive layer appeared to have changed little, and the removeability was also excellent.

Example 3

The same liquid dispersion as used in example 2, produced by dispersing elastic microspheres and an adhesive in 8% by weight of toluene, was used to coat the surface of 70 kg of wood-free paper by means of a knife-coating device--through a gauze-wire screen with somewhat larger mesh width than the one used in example 2--with the result that the amount applied was about 10g/m^2 after drying--and then subjected to a heat treatment for 5 minutes, at 120°C, to obtain a removable adhesive sheet.

The adhesive force of the adhesive paper, measured according to the Japanese industrial norm JIS-Z-1523 was 85 g/cm.

The adhesive sheet was adhered to newsprint and then again slowly removed from it. The fibers of the newsprint were not pulled off. After repeating the adhesion to and removal from a wood-free paper 50 times, the adhesive force of the adhesive sheet remained satisfactory. When the adhesive sheet was then adhered to newsprint attached to a wall, the sheet did not drop off, not even not after a day.

The condition of the adhesive layer and of the elastic microspheres on the adhesive sheet were examined using a microscope. A structure was observed in which the adhesive layer on the wood-free paper was developed in a pattern of circles with a radius of about 500 μm, in which almost a single layer of elastic microspheres was coated with the adhesive. The percentual surface portion of the adhesive-mixture layer with respect to the underlying carrier surface was about 70%.

The number of the elastic microspheres per unit area was minimally about 6,100 units/cm^2, maximally about 21,400 units/cm^2 and, on average, about 17,000 units/cm^2.

The thickness of the adhesive covering the elastic microspheres was about 1 μm in the thinnest area and about 25 μm in the thickest area.

Thus it was confirmed that the adhesion of the adhesive sheet obtained according to the invention had changed very little in comparison with the case in which the percentual surface portion of the adhesive layer with respect to the underlying carrier surface was 100%, and that its removability was also excellent.

Translator: Joseph J. Vaes
612-738-7605